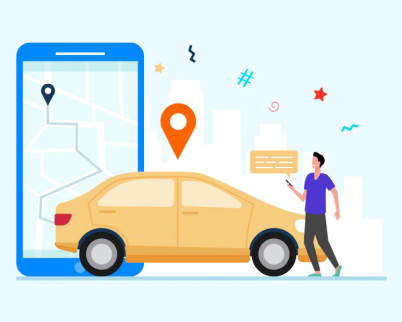
Karlsruher Institut für Technologie
Fakultät für Informatik
Lehrstuhl Algorithm Engineering
Prof. Dr. Peter Sanders

Praxis der Forschung 24/25

Algorithm Engineering for Software-Defined Public Transportation

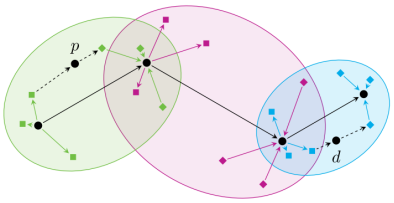
Description

Increasingly, calls for more sustainable living include the transformation of personal traffic from individual transportation (e.g. cars) to shared transportation (e.g. public transit, carpooling). However, current shared transportation systems often suffer from rigid planning, lack of coordination, and bad availability. Therefore, experts and policymakers envision future shared mobility based on *software-defined public transportation* (SDPT) where pervasive coordinated software enables transportation that is dynamic and efficient as well as socially and ecologically sound. The success of such systems hinges on methods like taxi sharing and dynamic transit to reliably and efficiently handle the diverse mobility needs of a population.

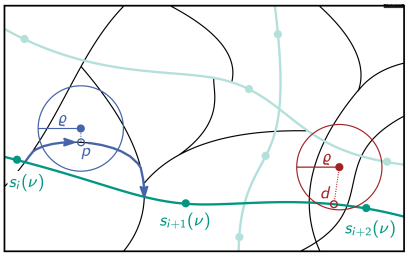


Algorithmic solutions for the dynamic analysis, scheduling, and planning of these means of transport need to be able to support tens of millions of journeys everyday in large metropolitan areas. Thus, we are concerned with analyzing central problems of SDPT and finding scalable algorithms for challenging *building-block problems* that serve to support future mobility systems.

As a step towards an integrated framework for scalable SDPT, we have previously considered dynamic taxi sharing with meeting points. We could show that good scalability can be reached by exploiting properties of the problem to further tailor state-of-the-art shortest path speedup techniques to this use case[1]. However, many exciting directions are left unexplored: For example, our taxi sharing dispatcher could benefit from fine-grained, engineered parallelism to improve scalability. Moreover, allowing travelers to transfer between different shared taxis or integrating the system with fixed public transit promises better service quality while presenting new interesting algorithmic challenges. Additionally, we require scalable algorithms for other problems in the area of SDPT to obtain a coherent framework.



Goal of this work: The goal of this PdF topic is to apply methods from algorithm engineering like cache optimization, fine-grained parallelism, branch optimization, etc to a problem in the area of SDPT. The supervisor and student will agree upon the exact problem based on the preferences and profile of the student.



Prerequisites

- Required: Interest in and knowledge of route planning algorithms (e.g. from a bachelor thesis or the “Algorithms for Route Planning” lecture)
- Required: Programming skills in C++ and basic scripting abilities
- Preferred: Knowledge in algorithm engineering (e.g. from a bachelor thesis or the “Algorithm Engineering” lecture)

[1] Laupichler, Moritz and Sanders, Peter. “Fast Many-to-Many Routing for Dynamic Taxi Sharing with Meeting Points”. ALENEX, 2024. https://doi.org/10.1137/1.9781611977929.6.

Moritz Laupichler
Informatikgebäude am Fasanengarten, Raum 207, moritz.laupichler@kit.edu